together with an apparent westward movement of the permanent area of low pressure in Smith's Sound, dominated the weather in the New England and middle Atlantic states.

The following table exhibits the principal facts regarding these low areas. The heading of each column shows to what the figures refer:

No.	First observed.			Last observed.		Duration.	Velocity per h'r.	Lowest pressure.			
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.			Date.	Station.	Reading.
		°	°	°	°	*Days.*	*Miles.*			*Inches.*
I.....	1	44	84	50	64	3.0	24	3	Chattanooga, Tenn.....	29.28
II.....	2	50	112	47	71	2.5	32	3	Winnipeg, Manitoba....	29.60
III.....	3	36	104	49	66	6.5	22	8	Chatham, N. B.....	28.90
IV.....	7	52	112	53	95	3.0	.....	8	Medicine Hat, N. W. T.	29.54
V.....	10	29	84	42	70	2.0	21	11	Charleston, S. C.....	29.36
VI.....	12	49	123	47	60	7.0	22	18	Bird Rocks, G. of St. L.	29.32
VII.....	12	41	84	42	69	2.0	17	12	Toledo, Ohio.....	29.60
VIII....	13	41	105	38	92	1.5	31	13	Denver, Colo.....	29.78
IX.....	17	42	114	48	66	4.0	28	19	Marquette, Mich.....	29.52
X.....	17	49	114	48	87	2.0	28	18	Minnedosa, N. W. T....	29.68
XI.....	19	50	127	53	107	1.5	.....	19	Calgarry, N. W. T.....	29.70
XII.....	20	35	108	45	62	2.5	31	24	Sydney, C. B. I.....	29.62
XIII.....	23	50	117	50	92	2.0	23	23	Calgarry, N. W. T.....	29.26
XIV.....	24	28	89	32	87	2.0	.....	25	Port Eads, La.....	29.84
XV.....	25	37	102	48	63	4.5	24	29	Chatham, N. B.....	28.86
XVI.....	27	51	125	54	108	1.0	.....	27	Edmonton, N. W. T....	29.67
XVII....	28	48	113	50	72	3.0	27	30	Minnedosa, N. W. T....	29.52
XVIII..	31	42	113	43	109	0.5	.....	31	Salt Lake City, Utah...	29.66
							25.4		Mean.....	29.41

The following is a description of some of the characteristics of these low areas:

I.—This was the continuation of ix of the last month noted over Lake Superior on the 30th. Its motion was nearly due east passing to the Saint Lawrence Valley on the 4th. Destructive storms occurred in Ohio and Georgia to the south and southeast of this storm on the 2d. The wind reached sixty miles per hour at Montreal on the morning of the 4th. As often noted before the precipitation in this and nearly all storms of the month was exceedingly irregular. For example; .15 inch at Sandusky; .03 at Parkersburg; .12 at Block Island; 1.64 at Erie; 1.50 at Buffalo, and 1.30 at Albany. It has generally been supposed that heavy local precipitation occurred almost exclusively in connection with thunder and other violent local storms in the summer, but here we have the same effect when there were no local storms. It would seem as though, after the pressure, the precipitation must give us a better idea of the forces acting at the seat of the storm and a study of its distribution and occurrence cannot fail to shed light upon many intricate problems.

II.—This low area was first noted on the 1st just north of Montana; its path just crossed within the boundary of Dakota on the 3d, and its last position was, on the 5th, in the upper Saint Lawrence valley.

III.—First noted in New Mexico on the 3d; its track was nearly northeast, disappearing in the upper Saint Lawrence valley on the 10th. In connection with this storm occurred the waterspout on the 7th, as noted elsewhere. In this storm .10 inch rain fell at Davenport, .26 at Block Island, .43 at Rochester, 2.96 at Kansas City, 1.98 at Fort Smith, 1.88 at New York City, 1.86 at Albany, 1.20 at Boston, 2.18 at Portland, and 3.26 at Eastport; these later-named comprise all the stations at which more than one inch fell.

IV.—This low area originated to the north of Montana on the 7th. Its path was entirely to the north of the boundary, and was last noted in Manitoba on the 10th.

V.—This storm was first noted on the 10th in the eastern Gulf; its motion was northeast, and it was last definitely located, by land observations, off the Massachusetts coast on the 13th.

VI.—This storm was first noted off the north Pacific coast on the 11th. Its motion was nearly due east, being last noted near Newfoundland on the 19th. The heaviest rainfalls during its progress were .72 at Cairo, .66 at Buffalo, and .84 at Parkersburg.

VII.—This storm was first observed in Ohio on the 12th. It slowly moved eastward, being last observed on the 14th off the Massachusetts coast. On the 14th a waterspout occurred to the southeast of the low centre.

VIII.—First noted in Colorado on the 13th; this disturbance moved rapidly in a path curving slightly to the southward, and gradually filled up on the 15th in Missouri.

IX.—This storm apparently had its origin near northern Nevada on the 17th. Its motion was a little north of east, and it was last noted in the upper Saint Lawrence valley on the 21st. During this storm .18 inch rain fell at Des Moines, .36 at Milwaukee and Keokuk, while 2.10 fell at Davenport, 1.92 at Indianapolis, and only .14 at Louisville. Severe local storms occurred in connection with this storm on the 19th in Maryland and New York.

X.—This disturbance first appeared north of Montana on the 17th. Its motion was a little south of east, and it was merged in ix over Lake Superior on the 19th.

XI.—This was first noted off the north Pacific coast on the 19th. Its motion was to the eastward, and it was last noted in Manitoba on the 20th, its path having been above the boundary.

XII.—In many respects this was the most interesting storm of the month. For several days previous to the 20th there were experienced unusual clouded skies and rainfall in southern California and western Arizona. While the rainfall on the immediate south Pacific coast was slight, .32 at Los Angeles and .25 at San Diego, yet the heaviest fall in October since the beginning of observations was noted at interior stations, 1.75 at Prescott, 1.09 at Yuma, 1.56 at Stanton, &c. At many of the stations the single fall in this storm exceeded all previous total falls for October. The disturbance reached Texas on the 22d; 3.92 rain fell at Galveston. The rainfall at New Orleans was also very heavy in the twelve hours ending the afternoon of the 22d, 3.74 fell, while only .33 fell at Port Eads. While a portion of this storm moved to the northeast, disappearing near Newfoundland on the 25th, a disturbance, an off-shoot, still remained in the western Gulf, which was xiv, as described below.

XIII.—This low area was first noted to the north of Idaho on the 23d. Its path was nearly due east, it gradually dying out near Lake Superior on the 25th.

XIV.—This disturbance was a portion of xii, which remained in the Gulf. Its path was traced a very short distance, as it gradually died out in Alabama on the 26th. It is probable that the water-spout of the 25th was a secondary effect of this storm.

XV.—On the 25th this disturbance appeared to develop gradually in Kansas. The motion was northeastward, and it disappeared near Newfoundland on the 29th. The lowest pressure of the month, 28.86, occurred at Chatham during the progress of this storm on the 29th.

XVI.—This disturbance was noted to the north of Washington Territory on the 27th. Its path was above the boundary, and it was last noted on the 28th in Manitoba.

XVII.—This storm was first seen in Montana on the 28th. Its path was due east, and on the last day of the month it had reached the Province of Quebec.

XVIII.—This storm originated in Idaho on the 31st, and was traced to Wyoming on the afternoon of the same day.

NORTH ATLANTIC STORMS FOR OCTOBER, 1888 (pressure in inches and millimetres; wind-force by Beaufort scale).

The paths of the depressions that appeared over the north Atlantic Ocean during October, 1888, are shown on chart i. These paths have been determined from international simultaneous observations by captains of ocean steamships and sailing vessels, received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

Eleven depressions have been traced, of which six advanced

northeastward over or near Newfoundland; one first appeared over the ocean between the Azores and Portugal; two apparently developed east of the Banks of Newfoundland, and two moved eastward from the American coast near the fortieth parallel. The storms generally followed normal east to northeast tracks in the vicinity of the American coast, while over mid-ocean they, in instances, pursued irregular paths. On the 10th a depression appeared over the eastern part of the Gulf of Mexico, from whence it is traced northeastward along the coast as land low area v. This depression attained great energy during the 11th, when it occasioned gales of hurricane force off the middle Atlantic coast of the United States.

The severest disturbances of the month occurred over mid-ocean east of the thirty-fifth meridian from the 25th to the 28th, inclusive, attending depressions numbers 7 and 8, whose tracks converged, and apparently united on the 25th.

In October, 1887, sixteen depressions were traced, of which eight were of tropical or sub-tropical origin; four advanced eastward over Newfoundland, one of which traversed the ocean from coast to coast; three moved northeastward from the middle Atlantic coast of the United States; one first appeared over the ocean northeast of Newfoundland, and one was located west of the British Isles on the last day of the month. The severest weather was experienced in the vicinlty of the British Isles during the last five days of the month.

In October, 1888, there was a marked deficiency in the number of depressions traced when compared with those charted for the corresponding month of previous years. Over the western part of the ocean generally unsettled weather prevailed, while in the vicinity of the British Isles the early part of the first and the latter half of the third decade were the only periods during which storms of marked violence were reported.

In the following descriptions of the depressions traced positions are given in degrees of latitude and longitude, except in cases where from twenty-five to thirty-five minutes have been cited, when they are given in degrees and half degrees:

1.—This depression was central on the 1st between Cape Breton Island and Newfoundland, from whence it moved northeastward and disappeared north of the fiftieth parallel. On the afternoon of the 1st strong sse. gales, veering to s., wsw., and nw. by w., and pressure falling to 29.40 (747), were reported south of Newfoundland.

2.—This depression was central about seven degrees east-northeast from the Azores on the 1st, from which position it advanced over the Bay of Biscay by the 2d, and subsequently disappeared over the continent of Europe, attended by fresh to strong gales, and pressure falling below 29.30 (744).

3.—This depression (low area i) passed eastward from the New England coast during the 3d, and by the 4th had moved northeast over the Gulf of Saint Lawrence, after which it advanced north-northeast beyond the region of observation. During these dates fresh to strong gales were reported off the coast of the United States to the thirty-fifth parallel.

4.—This depression (low area iii) was central off the western extremity of Nova Scotia on the 8th, from whence it advanced over the Gulf of Saint Lawrence by the 9th. During the next three days the storm-centre moved slowly eastward to the forty-fifth meridian, after which it recurved to the northwest, and, after the 14th, passed northeastward to the thirtieth meridian, where it disappeared after the 17th. During the 8th and 9th strong to whole se. to sw. gales prevailed south of Newfoundland and Nova Scotia, with barometric pressure falling below 29.20 (742), and on the 15th and 16th the depression was attended by strong to whole gales and pressure below 29.00 (737).

5.—This depression was a continuation of land low area v, which moved northeastward along the Atlantic coast of the United States, attended during the 11th and 12th by destructive hurricanes over the adjacent ocean. On the 14th the storm was central in about N. 40°, W. 67° 30′, from which position it moved east to the sixtieth meridian by the 15th. By noon, Greenwich time, of the 16th the centre had moved east-northeast over the Banks of Newfoundland, and during the following three days advanced slowly north of east and disappeared east of the twentieth meridian after the 19th. This depression possessed moderate energy during its passage over the ocean.

6.—This was a depression (low area vi) of moderate energy which passed from the vicinity of Prince Edward Island north-northeast over the Gulf of Saint Lawrence and Newfoundland during the 18th and 19th, and subsequently disappeared north of the region of observation.

7-8.—This depression is first charted in N. 44°, W. 42°, under date of the 20th, and from this date until the close of the month it pursued a slow, irregular northeast course, and passed to the northward of the British Isles. On the 25th this storm apparently united with a depression (number 8) which had moved from off the western extremity of Nova Scotia, where it was central on the 20th north-northeastward over Newfoundland and eastward over the ocean to the twenty-fourth meridian. The progress of the depression after the 24th was marked by pressure ranging below 29.00 (737) and storms of great violence.

9.—This storm (low area xii) was central on the south New England coast on the 24th, from whence it moved rapidly eastward over the ocean. The movement of the storm-centre was indicated by storm reports of shipmasters, which show that gales of hurricane force were encountered in the trans-Atlantic tracks west of the sixtieth meridian during the 24th and 25th, and that the centre crossed this meridian between the fortieth and forty-fifth parallels. Although reports will not admit of accurately locating the storm-centre after the 24th the rapidity of its advance would seem to warrant the belief that depression number 10 was its continuation.

10.—This depression was central on the 25th in N. 45°, W. 38°, with pressure below 29.30 (744), and fresh to strong gales over a considerable area. By the 26th the centre of disturbance had apparently moved east-northeast and united with depression number 7-8.

11.—This depression (low area xv) moved northeast over the Gulf of Saint Lawrenee and Newfoundland during the 29th and 30th, and, after the latter date, disappeared north of the region of observation. On the dates referred to strong to whole gales and barometric pressure falling below 29.50 (749) were reported to the southward of Newfoundland and Nova Scotia.

OCEAN ICE.

The following table shows the southern and eastern limits of the region within which icebergs or field-ice were reported for October during the last six years:

Southern limit.			Eastern limit.		
Month.	Lat. N.	Long. W.	Month.	Lat. N.	Long. W.
	° ′	° ′		° ′	° ′
October, 1883	46 56	46 22	October, 1883	46 56	46 22
October, 1884	Off Cape	Race	October, 1884	46 56	50 55
October, 1885	48 21	47 12	October, 1885	48 21	47 12
October, 1886	41 34	49 43	October, 1886	46 3	46 37
October, 1887	42 58	50 2	October, 1887	42 58	50 2
October, 1888	51 43	55 36	October, 1888	51 43	55 36

On chart i the positions of icebergs reported during October, 1888, are shown by ruled shading. Ice was reported on two dates only. On the 20th the s. s. "Lake Superior" passed one large berg two miles east of Belle Isle; on the same day the s. s. "Lake Huron" passed a large berg two miles south of Belle Isle. On the 23d the s. s. "Glendale" passed a berg in N. 51° 43′, W. 55° 36′.

In October, 1887, icebergs were reported on three dates; on the 15th, one very large berg in N. 42° 58′, W. 50° 2′; on the 29th, two large bergs and small pieces of ice in N. 52° 5′, W. 54°; and on the 31st, two large bergs, one in N. 51° 50′, W. 54° 23′, and the other in N. 52° 6′, W. 54° 8′.

In September, 1888, ice was reported south of the fiftieth parallel on two dates only. In the Straits of Belle Isle and

off the extreme northern coast of Newfoundland icebergs were observed on ten dates.

Compared with ice reported for October during the five preceding years a deficiency is shown for October, 1888. The southernmost ice was about six and one-half degrees north of the average southern limit, and the easternmost ice was about seven and one-half degrees west of the average eastern limit.

FOG.

The limits of fog-belts to the westward of the fortieth meridian are shown on chart i by dotted shading. In the vicinity of the Banks of Newfoundland fog was reported on eleven days as compared with sixteen days for September, 1888, and fourteen days for October, 1887. Between the fifty-fifth and sixty-fifth meridians fog was reported for a total of two days as compared with eleven days for September, 1888, and two days for October, 1887. To the westward of the sixty-fifth meridian fog was reported on five days as compared with eleven days for September, 1888, and four days for October, 1887.

As compared with September, 1888, the southern limit of the Newfoundland fog-belt has extended about one degree, while in the vicinity of the American coast fog was reported about three degrees further south than in the preceding month.

In the several instances in which fog was reported over or near the Banks of Newfoundland the presence or passage of a centre of low barometric pressure was noted to the northward or westward. On the two dates for which fog was encountered south of Nova Scotia a storm-centre was passing eastward over Nova Scotia. The development of fog off the coast of the United States was generally attended by relatively high barometric pressure and variable winds, following the passage of areas of low pressure to the northward.

The following are limits of fog-areas on the north Atlantic Ocean during October, 1888, as reported by shipmasters:

Date.	Entered.		Cleared.		Date.	Entered.		Cleared.	
	Lat. N.	Lon. W.	Lat. N.	Lon. W.		Lat. N.	Lon. W.	Lat. N.	Lon. W.
	° ′	° ′	° ′	° ′		° ′	° ′	° ′	° ′
1	47 00	46 00	46 00	49 00	18	45 00	59 30	45 25	58 01
3-4	48 00	45 00	46 00	51 00	19	46 18	47 47	46 02	48 40
4	54 17	44 48	54 10	45 20	20	46 53	47 59	46 47	48 12
8	At St. Johns, N.F.				21	45 17	49 07	46 08	46 17
8	43 00	61 40	42 30	63 04	23-24	New York.		39 50	73 40
8	41 02	66 48	41 08	67 05	24	36 30	74 40	36 50	74 37
8	46 44	47 05	45 51	50 09	27-28	35 20	75 15	37 57	75 00
9-10	44 00	51 20	46 16	44 32	28	40 30	72 00	Off Sandy Hook.	
9-10	48 22	48 42	47 26	52 28	28-29	Boston.		40 30	69 00
9-10	42 42	47 50	42 50	51 00	.....	.....	.....	.....	.....
10	42 36	50 05	43 10	48 00	.....	.....	.....	.....	.....
10-11	45 03	51 33	45 52	45 52	.....	.....	.....	.....	.....
12	49 24	43 10	49 09	44 27	.....	.....	.....	.....	.....

TEMPERATURE OF THE AIR (expressed in degrees, Fahrenheit).

The distribution of mean temperature over the United States and Canada for October, 1888, is exhibited on chart ii by dotted isotherms. In the table of miscellaneous meteorological data the monthly mean temperatures and the departures from the normal are given for stations of the Signal Service. The figures opposite the names of the geographical districts in the columns for mean temperature show the averages for the several districts. The normal for any district may be found by adding the departure to the current mean when the departure is below the normal and subtracting when above. Chart iii exhibits normal and current October temperature curves for selected stations.

The mean temperature was highest over southern Florida, where a reading of 79°.1 was reported at Key West. Values rising above 70° were also reported along the west coast of the Gulf of Mexico and in the lower Colorado valley. In the Sacramento and San Joaquin valleys the readings rose above 65°. The lowest mean temperatures occurred in northern Ontario, Canada, where they fell to 38°.4 at Rockliffe, and over the lower Saint Lawrence valley, Lake Superior, northern Minnesota, Dakota, and Manitoba, where they ranged below 40°.

The mean temperature corresponded with the normal over portions of New Brunswick, Nova Scotia, southeastern Texas, and New Mexico, and along a line traced from the northern boundary of Dakota and Montana southward and southeastward to the Gulf of Mexico between Galveston, Tex., and New Orleans, La. Over a greater part of the country east of the one-hundredth meridian the mean temperature was below the normal, the deficiencies being most marked from New Hampshire southwestward to eastern Tennessee, and along the Atlantic coast between the thirty-eighth and fortieth parallels, where they exceeded 6°. To the westward of the one-hundredth meridian the temperature was generally above the normal, the greatest excesses occurring in the middle Sacramento valley and over western Montana, where they exceeded 4°.

The following are some of the most marked departures from the normal at the older established Signal Service stations:

Above normal.	°	Below normal.	°
Sacramento, Cal	4.2	Rochester, N. Y.	6.8
Helena, Mont	4.2	Atlantic City, N. J	6.8
Fort Assinaboine, Mont	4.0	Albany, N. Y.	6.4
Olympia, Wash.	3.8	Columbus, Ohio	6.3
San Diego, Cal	3.8	Knoxville, Tenn	6.3

DEVIATIONS FROM NORMAL TEMPERATURES.

The following table shows for certain stations, as reported by voluntary observers, (1) the normal temperature for a series of years; (2) the length of record during which the observations have been taken, and from which the normal has been computed; (3) the mean temperature for October, 1888; (4) the departure of the current month from the normal; (5) and the extreme monthly means for October during the period of observation and the years of occurrence:

State and Station.	County.	(1) Normal for the month of Oct.	(2) Length of record.	(3) Mean for Oct., 1888.	(4) Departure from normal.	(5) Extreme monthly mean temperature for October.			
						Highest.		Lowest.	
						Am't.	Year.	Am't.	Year.
Arkansas.		°	*Years*	°	°	°		°	
Lead Hill	Boone	60.7	7	56.9	−3.8	65.6	1881	56.0	1885
California.									
Sacramento	Sacramento	60.4	22	57.6	−2.8	67.2	1875	54.7	1873
Connecticut									
Southington	Hartford	51.0	19	45.3	−5.7	56.1	1879	45.3	1888
Florida.									
Merritt's Island	Brevard	74.9	5	75.5	+0.6	76.2	1884	73.1	1885
Illinois.									
Aurora	Kane	51.0	10	47.4	−3.6	.....	.....	.....	.....
Golconda	Pope	60.8	11	55.6	−5.2	.....	.....	.....	.....
Greenville	Bond	57.7	10	51.5	−6.2	.....	.....	.....	.....
Peoria	Peoria	54.0	33	51.3	−2.7	62.7	1879	45.0	1869
Riley	McHenry	47.3	28	45.4	−1.9	.....	.....	.....	.....
Sandwich	De Kalb	51.5	38	51.0	−0.5	.....	.....	.....	.....
Indiana.									
Blue Lick	Clark	58.0	11	51.2	−6.8	.....	.....	.....	.....
Spiceland	Henry	51.2	34	48.7	−2.5	.....	.....	.....	.....
Vevay	Switzerland	56.2	22	51.7	−4.5	65.0	1879	46.5	1869
Iowa.									
Cresco	Howard	46.2	16	44.1	−2.1	.....	.....	.....	.....
Independence	Buchanan	48.0	13	46.0	−2.0	56.0	1879	45.0	1876
Monticello	Jones	49.5	35	46.2	−3.3	58.0	1879	36.0	1873
Kansas.									
Independence	Montgomery	58.2	17	56.5	−1.7	63.0	1881	52.2	1872
Lawrence	Douglas	54.4	21	53.0	−1.4	60.5	1879	44.0	1869
Yates Centre	Woodson	54.8	8	53.4	−1.4	58.8	1884	50.4	1885
Louisiana.									
Point Pleasant	Tensas	65.2	8	63.6	−1.6	.....	.....	.....	.....
Maine.									
Gardiner	Kennebec	47.2	52	42.9	−4.3	52.5	1879	42.8	1859
Maryland.									
Cumberland	Allegany	53.3	17	48.0	−5.3	60.0	1881	48.0	1888
Massachusetts.									
Somerset	Bristol	53.3	18	48.8	−4.5	.....	.....	.....	.....
Taunton	....do	53.1	17	46.8	−6.3	.....	.....	.....	.....
Michigan.									
Adrian	Lenawee	50.1	11	45.6	−4.5	.....	.....	.....	.....
Kalamazoo	Kalamazoo	50.6	13	47.4	−3.2	.....	.....	.....	.....
Thornville	Lapeer	51.4	12	45.9	−5.5	.....	.....	.....	.....
New Jersey.									
South Orange	Essex	53.2	19	47.6	−5.6	.....	.....	47.6	1888